WHAT IS CLAIMED IS:

1. A sensor for measuring gas permeability of a test material, comprising:

an electrically conductive sensing element that comprises a water and/or oxygen sensitive material, wherein the reaction of said material with water or oxygen when the sensing element is contacted with water and/or oxygen results in a change in the electrical conductivity of the sensing element, and

two electrodes electrically connected to the sensing element.

2. The sensor of Claim 1, wherein the electrodes provide electrical connection between the sensing element and an electrical signal evaluation means.

3. The sensor of Claim 1 or 2, wherein the water and/or oxygen sensitive material is selected from the group consisting of a conductive organic polymer, metal, metal alloy, metal oxide, and mixtures and combinations thereof.

4. The sensor of Claim 3, wherein the metal is calcium or magnesium.

5. The sensor of Claim 3, wherein the conductive organic polymer is selected from the group consisting of polyaniline, polypyrrole and polythiophene, polyacetylene, poly-p-phenylene, and polyvinylpyridine, thiophene-bipyridine copolymers, polypyridine, polybipyridine, and organometallic polyphenylenes.

6. The sensor of Claim 3, wherein the metal oxide is selected from the group consisting of VO_2, CrO_2, MoO_2, $LiMn_2O_4$, Cd_2SnO_4, $CdIn_2O_4$, Zn_2SnO_4 and $ZnSnO_3$, and $Zn_2In_2O_5$.

7. The sensor of any one of Claims 1 to 6, wherein the electrodes comprise an electrically conductive material selected from the group consisting of a metal, metal oxide and mixtures and combinations thereof.

8. The sensor of Claim 7, wherein the metal is selected from the group consisting of silver, gold, aluminium and copper.

9. The sensor of Claim 7, wherein the metal oxide is selected from the group consisting of indium tin oxide, aluminium zinc oxide, and indium zinc oxide.

10. The sensor of any one of Claims 1 to 9, further comprising a base substrate that supports the sensing element.

11. The sensor of Claim 10, wherein the base substrate comprises a polymeric material.

12. The sensor of Claim 11, wherein the polymeric material comprises an organic polymer selected from the group consisting of polycarbonate, polyethylene, polythersulfone, epoxy resins, polyethylene terephthalate, polystyrenes, polyurethanes and polyacrylates.

13. The sensor of Claim 11, wherein the polymeric material comprises an inorganic polymer selected from the group consisting of silicones, polydimethylsiloxanes, biscyclopentadienyl iron, polydichlorophosphazene and derivatives thereof.

14. The sensor of Claim 10, further comprising a barrier layer formed on the base substrate.

15. The sensor of Claim 14, wherein the barrier layer comprises a material selected from the group consisting of metals, metal oxides, ceramic oxides, inorganic polymers, organic polymers and mixtures and combinations thereof.

16. The sensor of any one of Claims 1 to 15, wherein the electrodes are located on a surface of the substrate.

17. The sensor of Claim 16, wherein the electrodes are spaced apart, thereby forming a trench.

18. The sensor of Claim 17, wherein the sensing element is located in the trench.

19. The sensor of any one of Claims 1 to 18, further comprising an encapsulation enclosing the sensing element.

20. The sensor of Claim 19, wherein the encapsulation comprises a polymeric material selected from the group consisting of epoxy polymers, polysulfide, silicone and polyurethane.

21. The sensor of Claim 20, wherein the encapsulation provides a hollow space around the sensing element.

22. The sensor of Claim 21, wherein the hollow space is filled with an inert gas.

23. The sensor of Claim 19, further comprising a cover substrate, wherein the encapsulation is formed as side (lateral) walls surrounding the sensing element, and the cover substrate is arranged to be in contact with the side (lateral) walls.

24. The sensor of Claim 23, wherein the cover substrate comprises a material selected from the group consisting of glass, aluminium and copper.

25. The sensor of any one of Claims 1 to 24, further comprising a protective layer covering at least a portion of the sensing element.

26. The sensor of Claim 25, wherein the protective layer comprises a material selected from the group consisting of a metal, a metal alloy, a metal oxide, a metal oxide mixture, a metal fluoride and an organic polymer.

27. The sensor of Claim 26, wherein the metal fluoride is selected from the group consisting of LiF and MgF_2.

28. The sensor of any one of Claims 10 to 27, further comprising a liner layer interposed between the sensing element and the base substrate.

29. The sensor of Claim 28, wherein the liner layer comprises an organic polymer.

30. The sensor of Claim 29, wherein the organic polymer is substantially permeable to gas.

31. The sensor of Claim 29 or 30, wherein the organic polymer is selected from the group consisting of acrylic polymers, and parylene type polymers.

32. The sensor of any one of Claims 28 to 31, wherein the liner layer comprises an inorganic polymer.

33. The sensor of Claim 32, wherein the inorganic polymer comprises a silicone-based polymer.

34. A method of producing a sensor for measuring gas permeability of a test material, said method comprising:

providing two electrodes, and

connecting an electrically conductive sensing element that comprises a water and/or oxygen sensitive material to said pair of electrodes.

35. The method of Claim 34, wherein the sensing element is deposited on a surface of a suitable base substrate.

36. The method of Claim 34 or 35, wherein the electrodes are deposited on a surface of a suitable substrate.

37. A system for measuring the gas permeability of a test material, said system comprising a sensor for detecting moisture permeation through the test material, said sensor comprising:

an electrically conductive sensing element that comprises a water and/or oxygen sensitive material, wherein the reaction of said material with water or oxygen when the sensing element is contacted with water and/or oxygen results in a change in the electrical conductivity of the sensing element, and

two electrodes electrically connected to the sensing element, wherein the electrodes provide electrical connection between the sensing element and an electrical signal evaluation means.

38. A method of determining the gas permeability of a test material using a sensor for measuring gas permeability of the test material, said sensor comprising:

an electrically conductive sensing element that comprises a water and/or oxygen sensitive material, wherein the reaction of said material with water or oxygen when the sensing element is contacted with water and/or oxygen results in a change in the electrical conductivity of the sensing element, and

two electrodes electrically connected to the sensing element, wherein the electrodes provide electrical connection between the sensing element and an electrical signal evaluation means,

wherein said method comprises:

i. contacting the sensing element with water and/or oxygen;
ii. measuring the changes in electrical conductivity of the sensing element over a period of time; and
iii. calculating the gas permeability coefficient of the test material based on the measurements.

39. The method of Claim 38, further comprising measuring the change in 1/f type noise spectrum density over the period of time.